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FABRICATION AND EVALUATION OF MECHANICAL BEHAVIOURS OF METAL MATRIX COMPOSITE FOR BRAKE DRUM

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ABSTRACT

This paper engages in the progress of AA6061 with Silicon carbide and Graphite particles, which can be used for automobile brake drum. Weight reduction, ease of use and desired mechanical properties need to be accomplished by this metal matrix composite. After the fabrication of the brake drum, it is to be tested for tensile, impact and hardness. A comparison made for different composition concludes the composite having better properties. The brake system is the most important system in the vehicle. It changes over the active vitality of moving the vehicle into warm vitality while halting. The essential elements of brake drums are to moderate the speed of the vehicle. Point of the undertaking is the car part light weighing is one of the significant objectives for growing light-weight elite segments. With a specific end goal to accomplish weight funds in vehicles, the light-weight high -performance components are increasingly using aluminum, magnesium, plastics, and composites. Developing lightweight and high strength component is made by the Hybrid composite material. The utilization of Hybrid composite is turning into a suitable answer for help the new controls of the Automobile business.

KEYWORDS: Brake Force, Brake Drum, AA6061, Metal Matrix Composites & Weight Reduction

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INTRODUCTION

A drum brake is a brake that usages pounding caused by a course action of shoes or pads that press outward against a turning chamber shaped part called a brake drum. The term drum brake ,for the most part ,suggests a break in which shoes push on the internal surface of the drum. Right when shoes push apparently of the drum, it is regularly called an attach break. Where the drum is pressed between two shoes, similar to a conventional plate brake, it is on occasion called a crush drum brake; however such brakes are for the most part remarkable. A related sort called a band brake uses a versatile belt or "band" wrapping around the outside of a drum.

Brake drum ought to be planned and created with such highlights to fulfill the above necessities. Rising fuel costs, shorter ceasing separation necessities, and the development of half- breed vehicles all prompt an expanded request in lightweight vehicle segments. Changing business sector needs to create inventive items. One inventive item is a lightweight aluminum metal grid composite (MMC) brake drum that is generously lighter than the customary cast press item.

The circle cast press with the sharp surface is embedded by aluminum, gives a solid attachment aluminum and high warmth exchange to aluminum. The outcomes demonstrated that the heap and the sliding separation influence the wear rate of the amalgams and the wear rate expanded with expanding load for both the composites (Chan, D. S. E. A.2004). The size and volume portions of the MMC fortifications, wear and scraping qualities and

additionally, elasticity was assessed (Garg, H. K 2012). The required material properties for motor applications are more prominent quality, light -weight, controlled warm development, high warm conductivity and great wear protection (Asif, M.,2011). Proposed aluminumbased composites with bring down wear protection have better tribological properties (Bodunrin, M. O., 2015). Fortified practically reviewed aluminum network composite barrels and non-strengthened aluminum chambers by centrifugal casting to get the microstructure and mechanical properties for assessment (Purohit, R 2012). Aluminum composites are broadly utilized as a part of aviation and car enterprises because of their low thickness and great mechanical properties, better consumer protection and wear, a low warm coefficient of development when contrasted with regular metals and alloys (Das, S. 2013).

MATERIALS

In this work, the base material are aluminum alloy (6061) in which Silicon carbide and graphite particles is used as reinforcement materials. The matrix material used in the experimental investigation was an aluminum alloy (6061). It has a low melting point of 660°C. Aluminum alloy in its unmodified state is extensively used in sand casting and die-casting. The molten metal has high fluidity and solidifies at the constant temperature. The reinforcement material used in the investigation was Silicon carbide and graphite particles. Particulates size was estimated by sieve analysis. Particle density is of 2.44 g/cm3 and melting point is of 1400°C.

FABRICATION

In this work, stir casting is used in producing metal matrix composite. In the induction type tilting furnace the Al is melted in the weighted proportion at 800°C temperature. The SiC and Graphite particles were placed in the separate furnace and preheated for 15 minutes and later sent into the melting furnace. A mild steel mechanical stirrer is used to stir at a speed of 500 rpm. In a molding die made of cast steel which for 1 hour preheated to 250°C, the casting will occur. A special coating of wolframite is put on the wall of the die to evade the molten metal from sticking to the die. Down pouring method is employed to minimize the casting defects. The machining of the cast to desired plate size is then done.

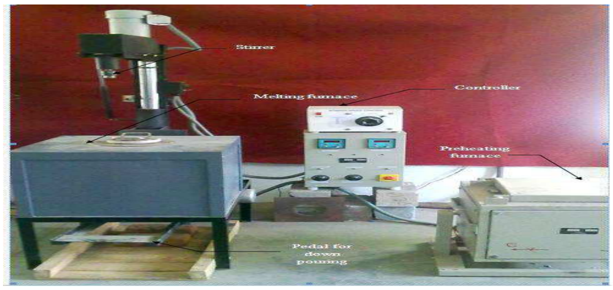

Figure 1: Lab setup of Stir Casting Furnace

The figure1 shows the stir casting furnace in lab setup where the experiment was done. The stir casting furnace specifications are listed in table 1 below.

Table 1: Stir Casting Furnace Specification

Specification	
Furnace temperature	800 ^{0}C
Stirrer speed	500 rpm
Metal Melting Temp	810 ^{0}C
Reinforcement Pre heating Temp in ^{0}C	250 ^{0}C
Stirrer Timing	5 min

For the experimental investigation, three samples are prepared and those samples have a different furnace conditions. The samples were named as Sample1, Sample 2 and Sample 3. Their Stir casting furnace condition during manufacturing is given in table 2 below. The sample ratios of base metal and reinforcement are given in Table 3.

Table 2: Stir Casting Furnace Condition

Work Pieces	Furnace Temp in ^{0}C	Metal Melting Temp in ^{0}C	Stirrer Speed in RPM	Stirrer Timing in min	Reinforcement Pre heating Temp in ^{0}C
Sample 1	780 – 810	770 – 780	500	5	552 – 560
Sample 2	780 – 810	775 – 785	500	5	579 – 595
Sample 3	780 – 810	775 – 790	500	5	606 – 617

Table 3: Ratio of Samples

S. No	Materials		Composition (wt %)		
			Sample 1	Sample 2	Sample 3
1	Base material	AA6061-T6	97%	97%	97%
2	Reinforcement	SiC	1 %	1.5 %	2 %
		Gr	2 %	1.5 %	1 %
3	Total		100%	100%	100%

TENSILE TESTING

At room temperature, the tensile tests were conducted on servo-hydraulic UTM (universal testing machine). According to ASTM E8M samples were prepared. By performing the tension test on standard cylindrical tensile specimens, the tensile properties of the alloys were determined. The tensile test samples are shown in figure 2.

Figure 2: Tensile Test Specimen Samples

Table 4: Tensile Testing Conditions and Result

S. No	Sample Work Piece	Gauge Length	Maximum Force(KN)	Nodal Diameter (mm)	Tensile Strength (KN/mm^2)	Percentage of Elongation
1.	Sample - 1	90	22.606	8	0.398	9.756
2.	Sample - 2	90	18.60	8	0.328	4.878
3.	Sample - 3	90	16.60	8	0.306	1.68

table 4 tabulates the tensile testing conditions and result. From the result, we can infer that the sample-3 has lesser tensile strength and elongation.

HARDNESS TESTING

Bulk and microhardness can be measured by Vickers hardness test. In this work, microhardness is calculated using Zwick/Roell Micro Vicker's hardness testing machine. The specimen is kept stationary on the anvil. A load of

50grams is made to act on the specimen for a time period of 10 seconds. Then the diagonals of the diamond indenter's imprint were measured from which the Vicker's hardness can be calculated. Five readings for each sample is taken and averaged to avoid the segregation effect of particles. The average hardness value for each sample is shown in table 5.

Table 5: Hardness Test Reading

S. No	Material	Hardness (VHN)
1	Sample 1	71.8 VHN
2	Sample 2	78.6 VHN
3	Sample 3	84.4 VHN

IMPACT TESTING

To determine the amount of energy absorbed by a material during fracture, Charpy v-notch test is conducted. Charpy v-notch test is a standardized high strain-rate test. The given material's toughness is measured as absorbed energy. By increasing the reinforcement particulates, the impact value will have a slight change which adds to material properties.

The specimen details of Charpy Impact testing has Length =75mm, Breadth=10mm and impact is calculated by Impact strength (I) = K/A, where K- Energy absorbed in J and A-Area in mm^2

Samples	Before impact testing	After impact testing
Sample 1		
Sample 2		
Sample 3		

Figure 3: Specimens before and After Impact Testing

Table 6: Charpy Impact Test Result

Workpiece	Energy Absorbed (K) in J	Impact strength(I) in J/mm^2
Sample-1	48	0.087
Sample-2	52	0.099
Sample-3	56	0.102

In this work, AA6061 brake drum was dispersed with different contents of reinforcement of SiC-(1%,1.5%,2%), Gr-(2%,1.5%,1%), is fabricated by using the stir casting way. The result of hardness, impact properties should be increased for adding the reinforcement of materials, whereas the tensile properties decrease. The above discussion deals with testing their properties and submitted the reading and proof of their testing.

CONCLUSIONS

Aluminum alloy composite resources are widely used for a many numbers of applications like engineering structures, aerospace and marine application, sporting goods and so on. Based on our work we have found that the weight to strength ratio for Al alloy 6061 with Sic + Gr is better. The good hardness and impact properties have been obtained at AA6061 97% Sic 1%& Gr 2% ratio. This indicates that the Aluminium silicon carbide graphite composite material is having less weight and more strength, it is especially much useful in automobile applications.

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